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BEFORE THE
POSTAL REGULATORY COMMISSION
WASHINGTON, D.C. 20268-0001

PRICE ELASTICITIES AND INTERNET DIVERSION	Docket No. RM2014-5

RESPONSE OF THE UNITED STATES POSTAL SERVICE
TO NOTICE OF INQUIRY NO. 1
(August 28, 2015)

On June 12, 2015, the Commission issued Notice of Inquiry No. 1 in this proceeding. It included seven questions relating to the Branching AIDS model and related topics. The Postal Service hereby responds. Each question is stated verbatim and followed by the response. Also attached is a report that is responsive to Question 2.b.

Respectfully submitted,

UNITED STATES POSTAL SERVICE

By its attorney:

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Eric P. Koetting

475 L'Enfant Plaza West, S.W.
Washington, D.C. 20260-1137
(202) 277-6333
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1. The Branching AIDS Model attempts to explain mailers' behavior in part by incorporating assumptions regarding allocation of mailers' expenditures across postal products (e.g., retail vs. commercial packages).

a. What, if any, assumptions regarding mailers' behavior, either included in the Branching AIDS Model or otherwise, should be incorporated into the postal demand and forecasting models and why?

b. What other factors that affect mailing choices should be reflected by the postal demand and forecasting models and why?

RESPONSE

a. As a general rule, it is desirable to incorporate as few assumptions as possible within a set of econometric equations. Rather, beyond general assumptions associated with basic economic theory, one should be careful to let the data, rather than assumptions, guide the results.

b. Ideally, models ought to include as many factors which affect mailing choices as possible. The full extent to which such factors can be included will be limited by the availability of data which quantify these factors, sample size limitations based on the amount of historical data available over which the equations are estimated, and multi-collinearity issues which may make it difficult to isolate the unique impact of multiple factors which are too highly correlated with one another.

2. The Branching AIDS Model includes “share equations” at the branching points where the aggregated postal revenues are divided by class of mail, then by mail categories, and finally, by shapes. [footnote omitted]

a. Would introducing share equations into the postal demand and forecasting models be useful? If yes, what kinds and why? If not, why not?

b. Please provide any available information regarding the “ongoing effort to estimate separate shape-based demand equations.” [footnote omitted]

c. What are the major obstacles for introducing share equations into the postal demand and forecasting models? What factors create these obstacles and how can these obstacles be overcome?

d. What kind of investigations (including, but not limited to, any analytical work or statistical testing) should the Postal Service perform to improve its demand and forecasting models by introducing share equations, similar to those outlined in the Branching AIDS Model?

e. If the Postal Service incorporates share equations into its demand and forecasting models, what is the most reasonable branching structure that would allow the Postal Service to calculate price elasticities at more disaggregated levels than it is currently capable of doing (e.g., by rate category or by shape)?

RESPONSE

a. Share equations of this type would be appropriate in cases where a specific mailer may choose from among alternate mail categories in sending a specific piece of mail. An example of this would be a sender of First-Class Workshared mail choosing from among alternate presort or automation categories. Share equations of this type are already incorporated within the Postal Service’s demand and forecasting models for First-Class and Standard Mail.

Share equations of this type would be inappropriate, however, in cases where the different mail categories being considered serve distinct postal markets. Shape distinctions within First-Class and Standard Mail – e.g., First-Class Single-Piece Letters vis-à-vis First-Class Single-Piece Flats – would be examples of mail distinctions that likely would be better modeled via wholly distinct demand and forecasting equations than via a share-based methodology.

b. Please see the report entitled, "Econometric Demand Equations by Shape for First-Class Mail and Standard Mail", which is attached to this NOI response.

c. – e. Please see the response to part a. As mentioned there, the Postal Service already estimates share equations associated with First-Class and Standard Mail. These share equations include a price factor – i.e., shares are modeled, in part, as a function of the worksharing discounts offered by the Postal Service. As such, it would be possible to calculate price elasticities at more disaggregated levels than the Postal Service traditionally shows. Such elasticities would be highly dependent on the specific prices in effect, however, and would be largely offset by corresponding cross-price elasticities. That is, the price responses captured by these share equations all involve shifts between mail categories in response to changes in relative Postal rates, but represent no net losses – or gains – to the Postal Service in response to overall price levels. As such, it is not clear what the utility of such calculations would be.

3. The Branching AIDS Model discussed at the technical conference found that changes in average revenue per-piece tend to be less than proportional to changes in fixed-weight price indices. This is because mailers may be able to adjust their mail mix within a mail category in order to mitigate some of the rate increases. [footnote omitted] Please discuss:

a. Implications this finding might have for revenue forecasting.

b. Any further evaluation that will be necessary before incorporating it into the postal demand and forecasting models.

c. The likely impact of incorporating this finding on the demand and forecasting models and the estimated elasticities.

RESPONSE

a. Certainly, forecasted revenue per-piece is an important component of revenue forecasting. It is important, however, to understand that, at its heart, any uncertainties regarding revenue per piece forecasts are simply uncertainties in volume at a level of detail below which volume forecasts are made. For example, the Postal Service already forecasts First-Class Cards volume by rate level. Consequently, it is virtually impossible to forecast the average revenue per-piece for First-Class Automation 3-digit cards wrong, because it only has the one price. Thus, any errors in the revenue per-piece forecasts for total First-Class Cards are because of errors in the mix of First-Class cards by presort and automation level implied by the underlying volume forecasts. The most straightforward way, then, to deal with persistent errors in the Postal Service's revenue per piece forecasts (assuming for the sake of argument that such errors exist) would be to work to either make volume forecasts at a finer level of detail or to work to improve the detailed volume forecasts already being made.

Related to this, it is also important to understand that the extent to which mailers can mitigate rate increases by adjusting their mix of mail will be highly dependent on the details of any specific rate increase. A straight across-the-board rate increase, for example (as was implemented – generally speaking – in Dockets. No. R94-1 and R2005-1) offers little incentive for mailers to make the kinds of mix adjustments discussed here. In contrast, rate increases which involve raising some rates while lowering others (e.g., MC95-1) offer much greater opportunities for such mitigation (although, in the case of MC95-1, rates were set to be revenue-neutral, so that the overall rate increase was very close to 0 percent, which would, of course, require no mitigation).

b. – c. In terms of estimating price elasticities, this issue is largely a distinction without a difference. Suppose, for example, the Postal Service has a model which modeled Standard Regular Mail volume as a function of a price index based on published rates, which produces an own-price elasticity of -0.5 so that a 5 percent increase in published rates will reduce volume by 2.5 percent.

Now, suppose somebody offered an alternate model, which posited that Standard Mail volume was a function of average revenue per piece, with an own-price elasticity of -0.625, and that the “elasticity” of revenue per piece with respect to published rates was 0.8. Now, a 5 percent increase in published rates will only translate into a 4 percent increase in average revenue per-piece, but, applying an own-price elasticity of -0.625 to a 4 percent increase in average revenue per piece would produce a reduction in mail volume of 2.5 percent - which is the same answer as the Postal Service found in the previous paragraph.

In other words, a particular “price elasticity” is a function of the specific measure of price used in its calculation, and one needs to be careful in comparing “price” elasticities which were estimated based on different measures of “price”.

4. As electronic diversion appears to have a major impact on postal demand, please provide responses to the following questions at the most disaggregated level of detail available.

a. What factors (e.g., technological, economic, societal, cultural, demographic, etc.) collectively define electronic diversion?

b. What variables that capture electronic diversion (aside from intervention variables or trends) are worth considering in the postal demand and forecasting models?

c. What are the sources of data for modeling electronic diversion?

d. Are there specific models that can be adopted for modeling electronic diversion of postal demand?

RESPONSE

a. Electronic diversion, as it is relevant to the estimation of postal demand equations and mail volume forecasting, is defined by the Postal Service as communications which could have been sent via the Postal Service but are, instead, sent via electronic alternatives (including, but not limited to, the Internet).

The factors enumerated here – technological, economic, societal, cultural, and demographic – may (or may not) affect the rate of diversion, but would not go directly to the definition or quantification of "electronic diversion" per se.

b. As discussed at length in the Postal Service's responses to Presiding Officer's Information Requests in Docket No. R2013-11 (e.g., POIR No. 6, question 25; POIR No. 9, questions 7, 10, and 11), the best econometric approach to modeling the level of electronic diversion has been found to be via Intervention variables and trends, as is currently done by the Postal Service. As was explained in Thomas Thress's response to Presiding Officer's Information Request No. 9, question 7, in R2013-11, this finding is not unique to the United States Postal Service.

British researchers Veruete-McKay, Soteri, Nankervis, and Rodriguez, came to a similar conclusion in a 2011 paper which investigated the demand characteristics of mail in the United Kingdom.

"The effect of technology on the erosion of mail volumes was explored in a number of ways. For example, model specifications including the proportion of households with internet and broadband access yielded broadly similar results to those reported in table 2. However, statistical criteria (for example, diagnostic test statistics, AIC and SBC information criteria and the standard error of regression) preferred models with time trend break terms. This could reflect the fact that changes in technology are dynamic in nature and unlikely to be reflected within the properties of a single variable or group of variables. For example, it could be the case that, potentially, time trend terms may be a better proxy for the combined and evolving impacts of different technologies, which individually can be modelled as being logistic in their effect on the demand for mail, but over time cumulate to yield "corrugated S-shaped" impacts that are better reflected by time trend terms and/or time trend break terms.[24]

[24] The technology variables tested in the econometric modelling included measures of the number of connections and subscribers to the internet in the UK; the index of broadband internet connections in the UK; the proportion of adults with access to electronic banking; and the proportion of UK households with access to the internet."

Veruete-McKay, Leticia; Soteri, Soterios; Nankervis, John C.; and Rodriguez, Frank (2011) "Letter Traffic Demand in the UK: An Analysis by Product and Envelope Content Type," *Review of Network Economics*: Vol. 10: Issue 3, Article 10.

c. N/A

d. The Postal Service believes that its current models represent, under the totality of existing circumstances, the best possible approach "for modeling electronic diversion of postal demand".

5. "Indirect competitors" (including, but not limited to, television, radio, periodicals or billboard advertising or long-distance telephone calls) might also have had an impact on postal demand.

a. What factors that reflect "indirect competitors" of the Postal Services are relevant to postal demand? If feasible, please provide the applicable factors separately for different types of "indirect competitors."

b. What relevant explanatory variables that capture the potential causes of changes in postal volumes due to "indirect competitors" should be included into the postal demand and forecasting models?

c. What data sources are available for modeling the impact of "indirect competitors" on postal demand?

d. Are there any models that could be adopted for modeling the impact of "indirect competitors" on postal demand? Please discuss.

RESPONSE

a. Certainly, direct-mail advertising (and, hence, the Postal Service) competes directly for advertising dollars with alternate advertising media, including television, radio, and magazines. It is also true that long-distance telephone calls can provide a viable substitute for some types of First-Class Mail.

Ideally, one would like to include as many factors which affect postal demand as possible within one's econometric demand equations. This ideal is, however, limited based on the availability of such data as well as sample size limitations related to the amount of available volume data at the level of detail at which the Postal Service seeks to estimate its equations.

b. In general, there are two types of variables which may be useful in attempting to measure the impact of competitors to the mail.

The first such type of variable would be measures of competitor volumes. The potential difficulty with including competitor volumes within postal demand equations is that the "correct" sign is uncertain. To the extent, for example, that television advertising and direct-mail advertising levels are driven by common trends in the overall advertising market, one might expect the coefficient on television advertising to be positive in a demand equation for Standard Mail. For many years, the Postal Service's demand equations for Standard Mail (and third-class mail before that) included total advertising expenditures, excluding direct mail, with a positive coefficient (see, e.g., Docket No. R94-1).

On the other hand, to the extent that increases in television advertising may be at the expense of direct-mail advertising, one might instead expect the "correct" coefficient on such a variable to be negative. This uncertainty regarding the expected relationship between television and direct-mail advertising volumes (for example) makes it difficult to assess the reasonableness of including such variables within postal demand equations.

Alternately, one can include measures of the price of competitors. The Postal Service has considered models of this type historically as well (see, e.g., the Standard Mail equations presented in Docket No. R97-1, as discussed in the response to part d. of this question). The biggest challenge with including cross-price measures of this kind in postal demand equations is in finding data on such things that regularly calculate and report competitor prices in a way that is comparable to postal prices. In terms of forecasting equations, there is also the additional challenge, then, of having to forecast competitor behavior in order to most accurately forecast mail volumes: a challenge which exists for both competitor volumes and competitor prices, of course.

c. See the response to part d. of this question.

d. The Postal Service has experimented with equations which have attempted to include such factors in the past. For example, the Standard Mail equations presented in Docket No. R97-1 included prices for alternate advertising media. Specifically, the Standard Regular Mail equation used in that case included measures of the prices of newspaper and television advertising, and the Standard ECR Mail equation used in that case included measures of the prices of newspaper and radio advertising. Unfortunately, the data available to the Postal Service to measure these prices were only available at an annual level and with a fairly long lag, which made them poor candidates for inclusion in econometric equations based on quarterly data and regularly updated.

Independent forecasts of these data were also not available. This meant that the Postal Service would have to forecast these prices themselves in order to incorporate them into a volume forecast. Again, this limits the usefulness of such data to the Postal Service.

The source for these data no longer provides such data, and the Postal Service is not aware of alternate sources for such data.

6. A reasonable alternative model may consider different consumer groups (each having its own set of preferred mail products) and model the postal demand separately by each group.

a. Is there a quantifiable connection between customer groups and classes of mail?

b. What sets of consumer groups should be defined for modeling postal demand?

c. What complications (in terms of data, econometric techniques, etc.) may arise using this modeling approach?

d. What other types of quantitative and qualitative analysis of mailers' behavior should be undertaken to improve the postal demand and forecasting models, and the accuracy of the estimated elasticities?

RESPONSE

a. The Postal Service's demand equations and forecasting models are structured at the level of detail of mail products because that is the level of detail at which the Postal Service ultimately requires volume forecasts.

Certainly, there are some cases where mail categories could be broadly interpreted as encompassing specific consumer groups. Standard Mail (direct-mail advertisers) and Periodicals Mail (newspaper and magazine publishers) would seem to be obvious examples of such connections.

b. Ultimately, the level of disaggregation at which postal demand equations are estimated is a function of the level of disaggregation at which (a) the Postal Service seeks volume forecasts and (b) the Postal Service has sufficient data.

c. The obvious tradeoff here would be the availability of reliable volume data suitable for use within an econometric equation.

d. To the extent that the variable of interest to the Postal Service is aggregate volume responses to price changes at the level of detail at which the Postal Service currently estimates demand equations and makes volume forecasts, the Postal Service believes that the econometric approaches currently undertaken are the most appropriate. Within this context, appropriate analyses to improve the equations would likely focus on the specific explanatory variables included within the Postal Service's models and the econometric techniques by which the relevant elasticities are estimated.

7. Data issues often cause problems for demand forecasting and accurate estimation of price elasticities on a disaggregated level.

a. Would disaggregating postal data by geographic area and estimating the demand models using panel data on the geographic areas and years be useful?

b. What data sources and spatial software would be required to perform such data disaggregation?

c. What proposed changes in the reporting of postal data could provide for more accurate estimates of the price elasticities on a more disaggregated level?

RESPONSE

a. No. Specifically as to the issue of price elasticities, the problem with relying upon disaggregated data by geographic area is that there are no differences in price across geographic areas. Consequently, even if one were to hypothetically disaggregate volume across seven geographic regions, this would theoretically produce seven times as much volume data, but would provide very little additional information on how mailers respond to price changes, because the number of price changes would remain unchanged.

b. N/A

c. The level of aggregation at which price elasticities can be estimated is a function of the level of aggregation at which data are available. For levels of disaggregation over which historical data are not currently available, even if such data were to begin to be reported by the Postal Service, it would still take several years for enough data to accumulate over enough distinct sets of prices to be able to even begin to estimate price elasticities at that level of detail.

Econometric Demand Equations by Shape for First-Class Mail and Standard Mail

Introduction

There has been growing interest, both within the Postal Service and elsewhere (e.g., the Postal Regulatory Commission), in identifying and understanding possible differences in demand by shape for First-Class Mail and Standard Mail.

Because of this, a great deal of effort has been expended attempting to model separate demand equations for First-Class Mail and Standard Mail by shape. These efforts have focused primarily on attempting to estimate distinct econometric demand equations by shape, which are built "from scratch". In general, the results have been found to be somewhat promising, but not as stable as at the broader subclass level over which these equations have traditionally been estimated. Consequently, there has been considerable reluctance to integrate these shape-based equations directly into the Postal Service's volume forecasting models.

Conceptual Approach

As a general rule, econometric results will tend to be more robust if the underlying mailers who make up the dependent variable associated with a specific demand equation are as similar as possible. Whenever possible, then, it is desirable to isolate different mailers or groups of mailers into separate groupings for the purpose of estimating econometric demand equations.

So, for example, to the extent that senders (or, at least, the demand drivers) of Standard Regular Letters may be different than the senders (or demand drivers) of Standard Regular Flats, it would be preferable to be able to estimate separate demand equations for Standard Regular Letters and Standard Regular Flats.

On the other hand, an econometrician can only estimate econometric demand equations based upon the data that are available to the econometrician. More data will provide for more robust statistical estimates and, hence, more reliable econometric equations (which, one would expect, would also lead to more accurate forecasting equations).

In the case of Postal equations, the previous two paragraphs represent conflicting goals. The more distinctive the mail categories, the less data are available over which to estimate equations. For example, First-Class Mail rates did not distinguish by shape prior to the implementation of R2006-1 rates in May, 2007. Before that time, rate distinctions were purely weight-based. Because of this, truly reliable First-Class Mail volume data by shape are not available prior to 2008 or so. Some data by shape has been estimated dating back to 2004, but even with that data, the available volume series for First-Class Single-Piece Flats has only recently reached 10 years' worth of data.

The Postal Service has recently explored a new approach to dealing with these two issues. This involves taking advantage of the longer data series associated with broader mail categories and the general commonalities across the demand for mail products within these broader mail categories by combining them into a single demand equation over a somewhat longer sample period, and using that aggregate equation as a way to provide ranges to guide econometric estimates for finer mail categories for which fewer data points are available.

This is conceptually similar to the Branching AIDS Model presented by Ted Pearsall at the Postal Regulatory Commission in August, 2014. The technique here actually goes even farther back. This was the technique used to first estimate separate demand models for what were then third-class non-carrier-route and carrier-route mail (and are now Standard Regular and Standard ECR mail) in Docket No. R94-1.

Differences in Demand Characteristics by Shape

Subclass-level (or "trunk") demand equations are estimated for First-Class Single-Piece Mail (Letters, Cards, and Flats), First-Class Workshared Mail (Letters, Cards, and Flats), Standard Regular Mail, Standard ECR Mail, and Standard Bulk Nonprofit Mail (Nonprofit and Nonprofit ECR. Separate shape-based equations are then estimated using stochastic constraints for the macro-economic and own-price elasticities which are calculated from these trunk equations.

The variance associated with the macro-economic restrictions is taken from the trunk equations while the variances for the own-price elasticity restrictions are taken from the category (i.e., "shape") equations (so that the own-price elasticities are, essentially, simple averages of the trunk and shape-level price elasticities).

The individual equations (e.g., First-Class Single-Piece Letters, Cards, and Flats) are estimated independently. So, there are no restrictions across the equations (that, for example, the average own-price elasticity across all shapes be equal to the trunk equation elasticity). Rather, the macroeconomic and own-price elasticities in the shape equations are constrained independently from the trunk equation.

The shape-level equations, then, could be used directly to make volume forecasts, with the trunk equation not used directly in forecasting, but only indirectly as a guide to ensure the reasonableness of the final forecast equations.

Results are presented next for First-Class and Standard Mail.

- First-Class Single-Piece Letters, Cards, and Flats

Recent revisions to RPW data had a significant impact on the reported volumes for First-Class Single-Piece Mail (especially Letters) over the past 10 quarters (2013Q1 – 2015Q2).[1] These revisions prompted some re-evaluation of the First-Class Single-Piece Mail equation vis-à-vis the equation which was most recently filed with the Postal Regulatory Commission (in January, 2015, estimated using (old) data through 2014Q4).

The final equation presented here for First-Class Single-Piece letters, cards, and flats demand equation, then, is estimated over a sample period from 1983Q1 through 2015Q2 and includes the following explanatory variables.

- Employment
- Own-Price: current and two lags
- Non-Linear Intervention starting in 2008Q1
- Four Linear Time Trends: starting in 1993Q4, 2003Q1, 2010Q2, and 2012Q4
- Several dummy and seasonal variables

The shape-based equations were constructed using the trunk equation as a model. Coefficients estimated with a stochastic restriction are italicized.

[1] Regarding the RPW revisions, see RM2015-9, filed June 12, 2015.

Table 1

	Trunk	Letters	Cards	Flats
Starting Date (ending date = 2015Q2)	1983Q1	2004Q1	2004Q1	2004Q1
Own-Price Elasticity	-0.148 (-2.042)	*-0.125 (-0.941)*	*-0.182 (-1.156)*	*-0.148 (-656.6)*
Employment	0.560 (9.347)	*0.556 (9.087)*	*0.557 (9.979)*	*0.571 (10.11)*
Time Trends				
Starting in 1993Q4	-0.0091 (-25.2)			
Starting in 2003Q1[2]	-0.0040 (-5.54)	-0.0136 (-14.0)	-0.0171 (-10.1)	-0.0160 (-12.9)
Starting in 2010Q2	-0.0141 (-4.76)	-0.0144 (-9.51)	-0.0144 (-5.95)	
Starting in 2012Q4	0.0116 (3.72)	0.0135 (5.34)	-	
Starting in 2014Q1				0.0121 (2.90)
Non-Linear Intervention				
Starting in	2007Q4	2008Q1	2008Q1	2008Q1
Initial Pulse	-0.029 (-1.696)	-0.045 (-2.242)	-0.065 (-1.738)	-0.057 (-2.143)
Lag Pulse	0.099 (3.792)	0.158 (1.555)	0.190 (1.329)	0.979 (4.739)
Long-Run Step Value	-0.130 (-3.460)	-0.079 (-3.803)	-0.085 (-2.688)	-1.000 (-4.623)
Rate of Attenuation	0.818 (5.300)	0.428 (1.590)	0.433 (1.534)	0.969 (105.1)
Dummy Variables				
R90-1 (D_R90)	-0.039 (-7.520)			
MC95-1 (MC95)	0.040 (4.098)			
2002Q1 (D2002Q1)	-0.039 (-2.358)			
2006Q1-2 (R2006PHOP)	-0.023 (-2.043)	-0.032 (-2.455)	-0.026 (-1.303)	
R2006-1 (D_R07)	-		-0.063 (-2.735)	-0.066 (-5.083)
Mean-Squared Error				
Full Sample	0.000231	0.000260	0.000572	0.000353
Last Five Years	0.000110	0.000122	0.000299	0.000232

[2] The shape-based demand equations all include a time trend over their full sample period, which starts in 2004Q1.

- First-Class Workshared Mail

The trunk equation for First-Class Workshared Mail follows a similar specification to what was most recently presented to the Postal Regulatory Commission (in January, 2015). As with First-Class Single-Piece Mail, however, recent evidence has suggested an attenuation in the recent negative trends affecting First-Class Workshared Mail volume[3]. Based on this, a positive trend has been added to the latest portion of the First-Class Workshared Mail sample period, similar to what was done above with respect to First-Class Single-Piece Mail.

First-Class Workshared Letters, Cards, and Flats, volume are modeled as a function of price (current and one lag), employment (lagged one quarter), a logistic time trend, linear time trends starting in 2002Q3, 2004Q1, 2010Q4, and 2014Q1, a non-linear intervention variable starting in 2008Q1, and a handful of dummy and seasonal variables.

The subclass equation was then used as a trunk equation from which separate equations were estimated for First-Class Workshared Letters, Cards, and Flats. The trunk equation was used in two ways.

First, the individual shape-based equation specifications exactly paralleled the trunk equation, with two exceptions.

The first exception is that the logistic time trend was removed from all three shape-based equations. This was done to avoid econometric difficulties in simultaneously estimating coefficients on a linear and logistic time trend over the same time period.[4] In addition, a dummy variable equal to one since the implementation of R2006-1 rates (in May, 2007; D_R07) was added to the shape-based equations. This rate change introduced some shape-based price distinctions for the first time and significantly increased those which had previously existed. This led to changes in the mix of First-Class Workshared Mail by shape, but (apparently) had no significant effect on the overall level of First-Class Workshared Mail as a whole.

Second, the employment and own-price elasticities were stochastically restricted in the shape-based equations based on the results from the trunk equation as described above.

Results for First-Class Workshared Mail are shown in Table 2 below. Restricted coefficients are italicized.

[3] For the first two quarters of FY 2015, First-Class Workshared Mail volume was 0.1% below the first two quarters of FY 2014.

[4] This is less problematic for the trunk equation, because the linear time trends do not begin until 2002Q3, leaving 8-1/2 years (34 quarters) for which the only time trend included in the equation is the logistic trend.

Table 2

	Trunk	Letters	Cards	Flats
Starting Date (ending date = 2015Q2)	1994Q1	2004Q1	2004Q1	2004Q1
Own-Price Elasticity	-0.325 (-5.539)	*-0.281 (-2.584)*	*-0.195 (-0.797)*	*-0.491 (-2.842)*
Employment (lag 1 quarter)	0.443 (3.165)	*0.381 (2.922)*	*0.448 (3.417)*	*0.413 (3.190)*
Logistic Time Trend	0.206 (16.91)			
Linear Time Trends				
Starting in 2002Q3	-0.0062 (-2.76)			
Starting in 2004Q1	0.0038 (1.55)	0.0010 (1.17)	0.0154 (7.07)	0.0115 (3.89)
Starting in 2010Q4	-0.0102 (-3.60)	-0.0084 (-1.70)	-0.0348 (-10.0)	
Starting in 2014Q1	0.0078 (3.00)	0.0066 (2.45)	-	
Non-Linear Intervention				
Starting in 2008Q1				
Initial Pulse	-0.029 (-2.236)	-0.023 (-1.391)	-0.047 (-0.990)	-0.160 (-2.485)
Lag Pulse	0.175 (3.039)	0.230 (1.611)	0.516 (7.133)	0.904 (3.178)
Long-Run Step Value	-0.171 (-2.690)	-0.222 (-1.418)	-0.407 (-7.933)	-1.000 (-3.310)
Rate of Attenuation	0.880 (13.86)	0.921 (12.14)	0.721 (12.35)	0.962 (59.37)
Dummy Variables				
MC95-1 (MC95)	-0.110 (-10.81)			
D_EL1 (Q1, Election Yrs)	0.004 (0.884)	0.007 (1.067)	0.016 (0.737)	
R2006-1 (D_R07)		-0.008 (-0.746)	-	-0.169 (-6.722)
Mean-Squared Error				
Full Sample	0.000114	0.000114	0.001294	0.001910
Last Five Years	0.000039	0.000032	0.000566	0.000616

- Standard Regular Mail

The trunk equation for Standard Regular Mail models the demand for Standard Regular non-parcels as a function of the following explanatory variables: the price of Standard Regular non-parcels, Investment, two linear time trends (one full-sample and a second starting in 2007Q2), and several dummy variables and intervention variables, including a non-linear intervention variable that starts in 2008Q1 and is tied to the Great Recession

The subclass equation was then used as a trunk equation from which separate equations were estimated for Standard Regular Letters and Standard Regular Non-Letters. As with the First-Class equations, the trunk equation was used in two ways. First, the individual shape-based equation specifications exactly paralleled the trunk equation. Second, the investment and own-price elasticities were stochastically restricted in the shape-based equations based on the results from the trunk equation.

Results for Standard Regular Mail are shown in Table 3 below. Restricted coefficients are italicized.

Table 3

	Trunk	Letters	Non-Letters
Starting Date (ending date = 2015Q2)	1988Q1	2004Q1	2004Q1
Own-Price Elasticity	-0.447 (-6.484)	*-0.427 (-2.068)*	*-0.472 (-3.414)*
Investment	0.367 (8.641)	*0.376 (9.940)*	*0.310 (7.970)*
Linear Time Trends			
Full-Sample	0.0068 (14.9)	0.0098 (6.43)	-0.0039 (-2.64)
Starting in 2007Q2	-0.0077 (-5.39)		-0.0207 (-4.93)
Starting in 2011Q2		-0.0098 (-3.62)	
Non-Linear Intervention			
Starting in	2008Q2	2008Q2	2008Q3
Initial Pulse	-0.029 (-1.100)	-0.033 (-1.396)	-0.048 (-1.910)
Lag Pulse	0.274 (2.944)	0.319 (5.506)	0.056 (0.760)
Long-Run Step Value	-0.173 (-5.673)	-0.249 (-9.517)	-0.180 (-1.848)
Rate of Attenuation	0.486 (3.440)	0.606 (8.216)	0.844 (2.193)
Non-Linear Intervention			
Starting in 1997Q1 (MC95)			
Initial Pulse	-0.048 (-1.976)		
Lag Pulse	0.078 (0.045)		
Long-Run Step Value	-0.083 (-4.651)		
Rate of Attenuation	0.118 (0.045)		
Non-Linear Intervention			
Starting in 1999Q3 (R97-1)			
Initial Pulse	0.075 (2.841)		
Lag Pulse	-0.047 (-2.313)		
Long-Run Step Value	0.082 (3.523)		
Rate of Attenuation	0.902 (8.356)		
Dummy Variables			
1996Q4 (D1996Q4)	-0.060 (-2.442)		
2002Q2 (D2002Q2)	-0.062 (-2.874)		
R2006-1 (D_R07)	0.038 (2.854)	0.058 (3.827)	-0.076 (-3.065)
2012Q1 (D2012Q1)	-0.077 (-3.346)	-0.081 (-3.662)	-0.041 (-1.968)
2012Q2 on (D2012Q2ON)	-0.147 (-8.331)	-0.141 (-7.880)	-0.093 (-5.940)
Election Dummy Variables			
Quarter 4, Presidential	0.014 (1.432)	0.018 (1.373)	0.051 (3.834)
Since 2008			
Quarter 1	0.030 (2.310)	0.026 (2.021)	0.053 (4.397)
Mean-Squared Error			
Full Sample	0.000384	0.000328	0.000271
Last Five Years	0.000185	0.000151	0.000138

- Standard ECR Mail

The trunk equation for Standard ECR Mail models the demand for Standard ECR Mail as a function of the following explanatory variables: the price of Standard ECR Mail, Investment, a full-sample linear time trend, and several dummy variables and intervention variables, including a non-linear intervention variable that starts in 2008Q4 and is tied to the Great Recession.

Results for Standard ECR Mail are shown in Table 4 below. Restricted coefficients are italicized.

Table 4

	Trunk	Letters	Non-Letters
Starting Date (ending date = 2015Q2)	1988Q1	2004Q1	2004Q1
Own-Price Elasticity	-0.842 (-9.102)	*-0.280 (-1.001)*	*-0.731 (-4.485)*
Investment	0.472 (18.33)	*0.474 (17.94)*	*0.461 (20.83)*
Linear Time Trend	-0.0022 (-5.60)		
<u>Non-Linear Intervention</u>			
Starting in	2008Q4	2009Q1	2008Q2
Initial Pulse	-0.040 (-1.627)	-0.028 (-0.631)	-0.008 (-0.278)
Lag Pulse	0.249 (10.39)	0.153 (2.672)	0.318 (10.82)
Long-Run Step Value	-0.232 (-10.09)	-0.107 (-1.892)	-0.318 (-9.336)
Rate of Attenuation	0.861 (32.41)	0.812 (4.809)	0.920 (39.61)
<u>Non-Linear Intervention</u>			
Starting in 1999Q3 (R97-1)			
Initial Pulse	-0.124 (-4.997)		
Lag Pulse	0.173 (5.401)		
Long-Run Step Value	-0.214 (-11.77)		
Rate of Attenuation	0.777 (14.25)		
<u>Dummy Variables</u>			
1999Q2 (D1999Q2)	-0.079 (-2.952)		
R2006-1 (D_R07)	-0.058 (-4.419)	-0.307 (-17.54)	
2012Q1 (D2012Q1)		-0.113 (-2.572)	
2012Q2 on (D2012Q2ON)		-0.050 (-2.154)	
<u>Election Dummy Variables</u>			
Quarter 3, Off-Year	0.017 (1.827)		0.028 (1.555)
<u>Since 2000</u>			
Quarter 1, Off-Year	0.049 (3.987)	0.066 (2.524)	0.028 (1.586)
<u>Mean-Squared Error</u>			
Full Sample	0.000427	0.001382	0.000609
Last Five Years	0.000490	0.000836	0.000521

- Standard Nonprofit Mail

Standard Nonprofit and Nonprofit ECR Mail volumes were combined within a single trunk equation. This equation models the demand for Standard Bulk Nonprofit Mail as a function of the following explanatory variables: the price of Standard Bulk Nonprofit Mail, Employment, a time trend starting in 2007Q2, several dummy variables, and a non-linear intervention variable that starts in 2009Q2 and is tied to the Great Recession.

Results for Standard Bulk Nonprofit Mail are shown in Table 5 below. Restricted coefficients are italicized.

Table 5

	Combined	Nonprofit Letters	Nonprofit Non-Letters
Starting Date	1988Q1	1988Q1	1997Q1
Own-Price Elasticity	-0.160 (-3.158)	*-0.160 (-20.25)*	*-0.167 (-0.623)*
Employment	0.525 (6.067)	*0.519 (6.054)*	*0.533 (6.004)*
<u>Linear Time Trends</u>			
Full-Sample	-	-0.0021 (-1.84)	-0.0033 (-1.12)
Starting in 2007Q2	-0.0063 (-5.88)		
Starting in 2011Q2		-0.0053 (-3.04)	-0.0117 (-2.73)
<u>Non-Linear Intervention</u>			
Starting in 2009Q2			
Initial Pulse	-0.073 (-2.464)	-0.071 (-2.551)	-0.109 (-2.133)
Lag Pulse	-0.134 (-1.587)	-0.139 (-0.530)	-3522.7 (-0.00)
Long-Run Step Value	-0.023 (-0.759)	-0.050 (-2.428)	-0.137 (-3.100)
Rate of Attenuation	0.554 (2.010)	0.324 (0.597)	0.000 (0.000)
<u>Dummy Variables</u>			
R2006-1 (D_R07)		0.062 (3.388)	-0.196 (-2.379)
<u>Mean-Squared Error</u>			
Full Sample	0.000659	0.000464	0.001931
Last Five Years	0.000505	0.000318	0.001256

	Nonprofit ECR Letters	Nonprofit ECR Non-Letters
Own-Price Elasticity	*-0.364 (-1.312)*	*-0.563 (-2.405)*
Employment	*0.521 (6.378)*	*0.521 (6.115)*
<u>Linear Time Trends</u>		
Full-Sample	-0.0042 (-2.34)	
Starting in 2011Q2		
<u>Non-Linear Intervention</u>		
Starting in	2008Q4	2009Q1
Initial Pulse	-0.291 (-3.181)	-0.134 (-1.555)
Lag Pulse	-0.435 (-5.260)	0.051 (0.373)
Long-Run Step Value	0.000 (--)	-0.234 (-4.645)
Rate of Attenuation	0.890 (20.60)	0.739 (1.003)
<u>Dummy Variables</u>		
R2006-1 (D_R07)	-0.224 (-3.530)	
<u>Mean-Squared Error</u>		
Full Sample	0.006422	0.003985
Last Five Years	0.004675	0.002363

Conclusions and Areas of Continuing Investigation

The approach outlined here seeks to strike a balance between gleaning as much information as one can from the longer history (and correspondingly longer sample periods) associated with the equations estimated at the “subclass” level which have traditionally been used by the Postal Service, while allowing the data that are available to identify demand differences by shape that can then be used to produce better shape-based volume forecasts.

The results here are, however, somewhat preliminary in nature, and work is ongoing to improve these results.